POWER SUPPLY REQUIREMENTS AND VOLTAGE CALCULATIONS FOR CABLE POWERED CATV SYSTEMS

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I am reminded repeatedly of how very basic and straightforwared calculating voltage drops and subsequent amplifier voltage inputs is. I have learned, that unless calculations are made on a consistant basis, though they are basic, aren't quite as straightforward to the average technician as one may think. If the Chief Engineer, Design Engineer or whoever is not familiar with how to calculate voltage drops and subsequent voltage inputs to the various amplifiers, the end result can be very costly. The following is an attempt to show and or explain how these calculations are made, so that the end result will be a well-designed power distribution system as well as a well-designed RF system.

Some basic rules of thumb will keep you in the ball park.

30 Volt Systems

1. Approximately two (2) trunk stations in both directions of the power supply with no more than three (3) extenders off of each one.

2. Minimum input voltage to an amp should not be less than 22 Volts AC.

60 Volt Systems

1. Approximately three (3) trunk stations in both directions of the power supply.

2. Minimum input voltage to amp should not be less than 45 Volts.

3. No more than three (3) extenders per trunk station.

These are merely rules of thumb that will do nothing more than get you in the ball park prior to the actual calculations. Do not use just the rules of thumb without actual calculations or you will get into trouble.

Remember: IR drop is the voltage drop in the cable preceding the amplifier and is equal to the total current associated with that drop times the loop resistance of that drop.

Loop resistance is defined as the resistance of a piece of cable shorted at one end and measured at the other between shield and center conductor. The unit of measure is in ohms. In manufacturer specs., it is usually given in ohms per 1,000 feet.

You must look up the loop resistance for the cable in your system. In the majority of our cable systems, constant current amplifier power supplies are used and the manufacturer's specs. can be obtained from the amplifier literature.

The current requirements are greater for amplifiers in 30 volt systems than for 60 volt systems.

Most modern day systems are built with 60 volt power supplies, as more amplifiers may be fed per power supply and surge immunity is improved.

The current state of the art amplifiers utilize what are called switching regulator type power supplies, whereas the current is not as constant as is the power. The Jerrold SJ amps are of this type. The manufacturer's specs. for these types of amplifiers gives the power requirements of each station. For the purpose of this paper, you are to utilize the average current given in the manufacturer's specs. in the described procedure for calculating IR drops.

EX: Model SJ-1 A trunk station, power requirements utilizing the SPCM switching regulator type power pack, is 31 watts (approximately .52 amps at 60 Volts).

The Starline One series amps utilize constant current power supplies, as do amplifiers utilizing the SPP-30 and 60 volt power packs. These are often referred to as constant current series regulator type power supplies.

Exhibit A will take you through the calculations for IR drops and subsequent input voltages to each amp for a 60 volt system utilizing Jerrold push pull amps with SPP-60 volt power packs.

Refer to Exhibit A

$E_{drop(A)}$ = I_T (total current required of amplifiers in Section Z) X

R (loop resistance of .750 cable between power supply and amp #3)

= 3.05 (amps) X .63 (ohms)

= 1.92 Volts

$E_{drop(B)}$ = I_T (total current required of Section X) X

R (loop resistance of cable between amp #3 & 4)

= 1.85 (amps) X 1.26 (ohms)

= 2.33 Volts

Amp #4 Voltage Input = Power Supply

Voltage - $E_{drop(A)}$ - $E_{drop(B)}$ =

60 - 1.92 - 2.33 = 55.75 Volts

$E_{drop(C)}$ = I_T (total current requirement of Section Y) X

R (loop resistance of .750 cable between power supply and amp #2)

= 3.05 (amps) X .63 (ohms)

= 1.92 Volts

$E_{drop(D)}$ = I_T (total current requirement of Section W) X

R (dc loop resistance of .750 cable between amp #2 & 1)

= 1.2 X 1.26 = 1.51 Volts

Amp #1 Voltage Input = 60 - $E_{drop(C)}$ -

$E_{drop(D)}$ = 60 - 1.92 - 1.51 =

56.57 Volts

Amp #3 Voltage Input = 60 - 1.92 =

58.08 Volts

Amp #2 Voltage Input = 60 - 1.92 =

58.08 Volts

After the Input Voltage to each trunk station has been established, IR drops for distribution lines are calculated and subsequent input voltage to each extender. Once input voltage to each trunk station has been established, it becomes the source voltage for all extenders off that trunk station.

Input voltage to each extender off a trunk station is then figured as follows:

Compute the IR drop for each extender in cascade off each distribution leg of the associated trunk amp, beginning with the furthest extender in cascade. Remember to add the required current of each preceding extender as you calculate IR drops towards the trunk amplifier. Input voltage to the furthest extender off a trunk amp is equal to the trunk amp input voltage minus the total of all IR drops in between the trunk amp and the furthest extender.

EX: Distribution leg with three extenders off of amp #4.

1. Figure IR drops first.

Extender "A" IR = .35 amps X 1.44 ohms

(2.4 X .6) = .50 Volts

Extender "B" IR = .35 amps X 1.44 ohms

(2.4 X .6) = .50 Volts

Splitter to Extender "C" = .7 amps

(I_A + I_B) X .48 ohms (2.4 X .2) -

.34 Volts

Extender "C" IR = 1.05 amps ($I_A + I_B + I_C$) X 1.56 ohms (2.4 X .65) = 1.64 Volts

Voltage Input Extender "A" = 55.75 Volts (voltage input to trunk amp #4) - 1.64 Volts (IR_C) - .34 Volts ($IR_{Splitter}$) - .50 Volts (IR_A) = 53.27 Volts

Voltage Input Extender "B" = 55.75 Volts (voltage input to trunk amp #4) - 1.64 Volts (IR_C) - .34 Volts ($IR_{Splitter}$) - .50 Volts (IR_B) = 53.27 Volts

Voltage Input to Splitter = 55.75 Volts (voltage input to trunk amp #4) - 1.64 Volts (IR_C) - .34 Volts $IR_{Splitter}$) = 53.77 Volts

Voltage Input to Extender "C" = 55.75 Volts (voltage input to trunk amp #4) - 1.64 Volts (IR_C) = 54.11 Volts

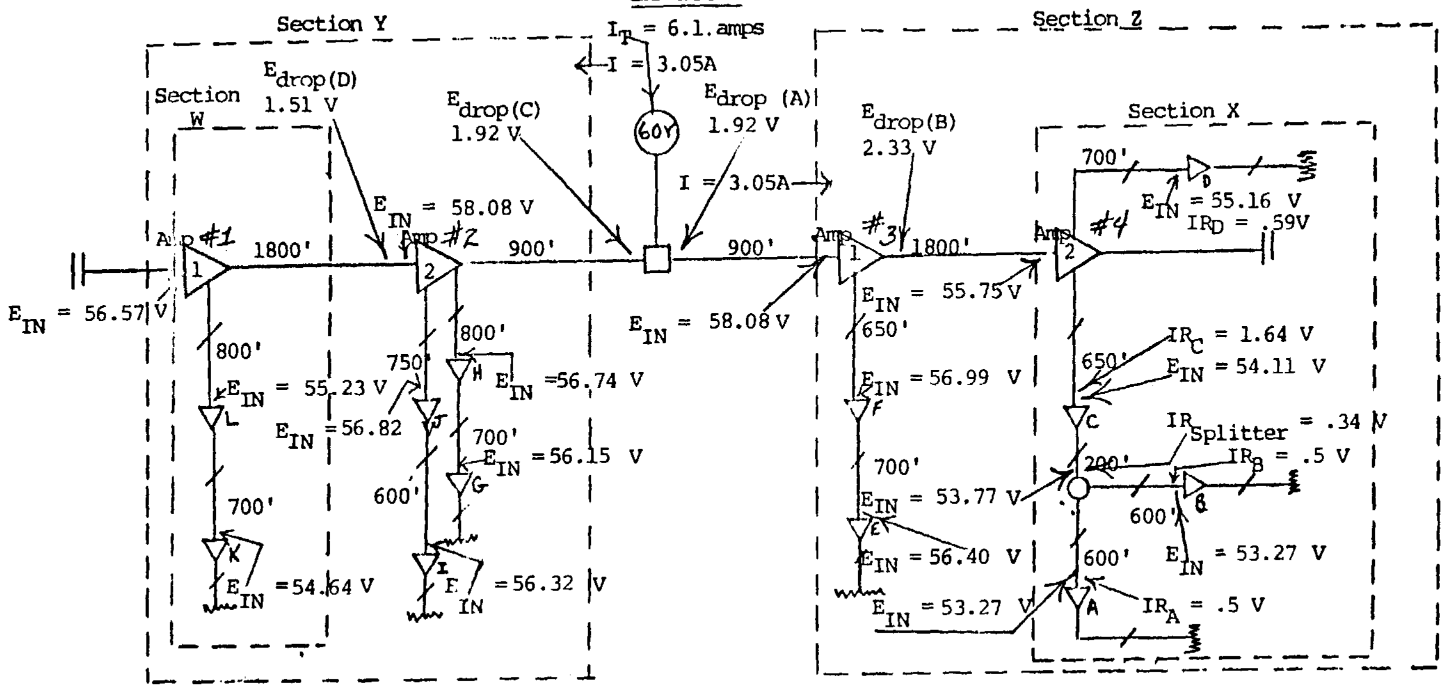
NOTE: For each leg off of a splitter, where line extenders are involved, IR drops are figured for each leg back to the splitter. Input voltage to the last extender off a splitter leg is calculated as shown above for extenders "A" and "B". Subtract all IR drops between the extender and the trunk amp, from the trunk amp input voltage. DON'T INCLUDE ANY IR DROPS OFF ANY OTHER LEGS OF THE SPLITTER!! These legs are calculated in the same manner as the one just described, excluding, of course, the IR drops of the other leg or legs of the splitter.

The same calculations may be used for 30 volt systems, only the current requirements of the amplifiers will change.

Total current drain of the main power supply is calculated by simply adding the current requirements of all stations off each power supply leg and then adding them togehter for the total. See Exhibit "A".

If there are any questions on this paper, please call or write me.

Exhibit A



Symbols

line with slash	.412
plain line	.750
▷	SLE - 300 Extender
□	Power Inserter
○	Splitter
zigzag	Terminator
large ▷	SP-1 & 2 Amps
60V in circle	Main Power Supply

Loop Resistance

.750 = .7 Ω /1000'

.412 = 2.4 Ω /1000'

Amplifier Current Requirements

SLE - 300	.35 A @ 60 V
SP - 1	.5 A @ 60 V
SP -2	.45 A @ 60 V